

channels in the 150-174 and 421-512 MHz bands. License applications will not be accepted until one year after the effective date of the rules adopted in this proceeding for channels 7.5 kHz removed from any currently listed channel in the VHF band and for channels 6.25 kHz removed from any existing channel in the UHF bands. This date will permit manufacturers sufficient time to obtain type acceptance for equipment that complies with our new technical requirements which dictate that equipment after this date be capable of operating with 12.5 kHz or less channel bandwidth or with narrowband equivalent efficiencies.⁹² The time lapse between adoption of the new rules and licensing on these new frequencies will also permit frequency coordinators time to establish proper coordination procedures for these frequencies.

D. Consolidation of Radio Services

42. Proposal. The Refarming Notice proposed consolidating the radio services in the PLMR bands below 800 MHz.⁹³ Specifically, we proposed to either consolidate the current radio services into three broad categories: a Public Safety radio service, a Non-Commercial radio service, and a General Category radio service⁹⁴ or to retain the current services with their existing channel assignments, but assign all new frequencies to the new broad categories.⁹⁵ In the Refarming Notice, we also proposed that there would be multiple coordinators for the consolidated radio services. Applicants could go to any recognized coordinator for the appropriate radio service.

43. A system of narrowly defined radio services has been in place for decades. The

⁹² This action is comparable to our decision to not issue licenses in the 220-222 MHz band until type accepted equipment became available. See Report and Order, PR Docket No. 89-552, 6 FCC Rcd 2356, 2365 para. 69 (1991).

⁹³ The twenty (20) PLMR services which are the focus of this proceeding are the Public Safety Radio Services (Local Government, Police, Fire, Highway Maintenance, Forestry-Conservation, and Emergency Medical), the Special Emergency Radio Service, the Industrial Radio Services (Power, Petroleum, Forest Products, Video Production, Relay Press, Special Industrial, Business, Manufacturers, and Telephone Maintenance), and Land Transportation Radio Services (Motor Carrier, Railroad, Taxicab, and Automobile Emergency).

⁹⁴ Under the Refarming Notice, the Public Safety Radio Service would combine the current public safety services into a radio service similar to the current Local Government Radio Service. The Non-Commercial Radio Service would be defined, as in the 220 MHz band, for internal use by an entity. The General Pool would essentially be the current Business Radio Service, which includes commercial entities.

⁹⁵ Refarming Notice at paras. 17-19.

separate radio services were designed to aid in the ease of operation in the assignment of frequencies and to respond to the varied needs of the user community. However, a disadvantage of the system became evident as channel utilization became uneven across the PLMR services.⁹⁶ Recognizing the disparities in channel usage among the PLMR services, in 1981 the Commission instituted rules to facilitate sharing among various radio service categories below 470 MHz.⁹⁷ The rules provided that in the 150-174 MHz and 450-470 MHz bands, where no satisfactory frequencies are available within an applicant's own radio service in the desired area of operation, an applicant may be assigned channel(s) available in a different radio service.⁹⁸ In instituting these rules, within a category of users, frequencies allocated to one radio service may be used in another radio service in the same category.⁹⁹ The advance of interservice sharing demonstrated the benefits of users reaching beyond their narrowly defined category of services to satisfy their frequency needs.

44. The Refarming Notice recognized that as the need for spectrum has increased, the practice of interservice sharing has become more common in the PLMR environment. However, because of the multiplicity of radio services, the practice of interservice sharing has become more difficult to implement because it is time consuming, expensive, and burdensome.¹⁰⁰ In terms of usage patterns, the current allocation system for the radio services inhibits spectrum efficiency by making certain spectrum efficient technologies more difficult to implement. Some digital multiple access techniques, including time division multiple access (TDMA), require several adjacent channels to operate efficiently. Because specific channel allocations for each of the radio services are generally scattered within the PLMR bands, rather than in contiguous blocks, spectrum necessary to implement such techniques is difficult to amass.¹⁰¹ The Refarming Notice, cited the Joint Commenters who note that "[w]ithout consolidation, the industry may find it cumbersome to implement

⁹⁶ In the Refarming Notice, we noted that a study of our licensing database in April, 1992, showed very wide variations in usage, often exceeding factors of ten for channels in the same frequency band designated for different radio services. Refarming Notice at para. 14.

⁹⁷ Report and Order, PR Docket No. 81-110, 46 Fed. Reg. 55701 (1981).

⁹⁸ 47 C.F.R. § 90.176.

⁹⁹ The Commission established separate categories of users for the purposes of interservice sharing including Public Safety Radio Services, the Special Emergency Radio Service, Industrial Radio Services, and Land Transportation Radio Services.

¹⁰⁰ Refarming Notice at para. 16.

¹⁰¹ Inquiry at para. 85.

spectrum efficient technologies... in the bands below 470 MHz." ¹⁰²

45. In the Inquiry, we noted that certain radio services share many of their channels and could be consolidated without significant impact on the groups eligible for those channels. ¹⁰³ Thus, for the reasons set forth above, the Refarming Notice proposed establishing a system of consolidation to introduce a greater degree of flexibility in the assignment of frequencies and maximize the benefits of the PLMR spectrum.

46. **Comments.** There is no industry consensus on the subject of consolidation of PLMR radio services. The comments filed are evenly divided on whether to consolidate the radio services. However, all oppose the Refarming Notice's proposal to consolidate into 3 generalized pools: public safety, non-commercial, and general. Several commenters provide alternative plans suggesting 4-6 radio service pools. For example, ITA, NABER and the Joint Commenters (ITA, CICS, and TELFAC) support a reduction in the number of service pools, but suggest that there should be four or five service pools rather than the proposed three. ¹⁰⁴ Those who support consolidation state that the radio services have evolved considerably over the past 30-60 years and that significant changes are necessary. Many note that maintaining 20 services is burdensome and results in inefficient, time consuming assignments of licenses to users. ¹⁰⁵

47. The interservice coordination and sharing may also be improved with consolidation. ¹⁰⁶ For example, reducing the number of services could improve spectrum efficiency in that users such as police and fire eligibles in the Public Safety pool, could be allocated channels from the same pool of frequencies and can therefore, utilize shared systems. Ericsson and SEA note that consolidation should make it easier to develop contiguous blocks of spectrum. In addition, a pool arrangement could eliminate the duplicative coordination fees that are often imposed on an applicant when he/she is forced to access channels in a radio service other than his/her own.

48. In contrast, public safety, land transportation, and industrial communities

¹⁰² Refarming Notice at para. 16.

¹⁰³ For example, the Interurban Passenger, Interurban Property, Urban Passenger, and Urban Property Radio Services are already treated in our rules as a combined Motor Carrier Radio Service. See 47 C.F.R. §§ 90.89 and 90.555. The Motion Picture Radio Service shares each of its channels with either the Special Industrial or Relay Press Radio Services. See 47 C.F.R. §§90.69 and 90.555.

¹⁰⁴ Joint Comments of ITA, CICS, and TELFAC at 22 and NABER at 22-26.

¹⁰⁵ Joint Comments of ITA, CICS, and TELFAC at 22.

¹⁰⁶ Comments of Ericsson GE Mobile at 22-23; Comments of PowerSpectrum, Inc. at 8.

generally oppose the consolidation proposal. AAR strongly opposes any change of the PLMR service categories. They argue that any change in the PLMR service pools would negatively effect the frequency coordinator function. "[A]ny change of the PLMR service categories and frequency coordinator functions ... would deprive the railroads of exclusive use and control of the frequencies that are allotted to them. The national and international scope of the railroad industry and the critical safety aspects of its mobile radio applications are unique among PLMR users and require a separate service category..."¹⁰⁷ Further, while NABER favors consolidation of the service pools, it notes that creating multiple coordinators in the various pools may result in a deterioration in the quality of frequency recommendations.¹⁰⁸ Those who oppose consolidation do so in part based upon concern over the Commission's proposal to have multiple coordinators for the consolidated services.¹⁰⁹ In addition, many note the lack of a common database as a factor preventing consolidation. Some argue that consolidation will unnecessarily complicate and reduce the effectiveness of the frequency coordination process. Some parties state that safety may be compromised if the services are consolidated. APCO indicates that the current service blocks have served public safety well, and should not be eliminated.¹¹⁰ Likewise, IMSA, IAFC, and the National Association of State Emergency Medical Service Directors oppose the consolidation proposal and state that the Commission should maintain discrete public safety services.¹¹¹ Thus, all public safety entities claim they cannot effectively share with other public safety entities and urge retention of the current system.

49. The Industrial and Land Transportation entities also oppose consolidation. AMRA states that "[t]he Commission has not explained adequately why it wishes to abolish a spectrum management program that has served the interest of land mobile users so well over half a century." They argue, "the proposal to group all land mobile licensees into 3 arbitrary

¹⁰⁷ Comments of AAR at 6-7.

¹⁰⁸ Comments of NABER at 30.

¹⁰⁹ Comments of Celpage at 15; Comments of the Coalition of Industrial and Land Transportation Land Mobile Radio Users at 12-13. (Coalition includes Manufacturers Radio Frequency Advisory Committee, Inc., American Trucking Associates, Inc., Forest Industries Telecommunications, and International Taxicab and Livery Association.

¹¹⁰ APCO further argued that, if the Commission consolidates Public Safety radio frequencies into a single radio service, it must designate a single public safety coordinator for all those channels.

¹¹¹ The public safety community is one of the most important users of the radio spectrum. Sufficient mobile communication capacity for agencies charged with protecting the public welfare is of critical importance to the overall well being of this nation. Some of the public safety services include, Police, Fire, Highway Maintenance, Emergency Medical and Special Emergency Radio Services.

groups ignores the specialized requirements of land mobile communications of many user groups, the inherent different priorities in the use of radio, and the successful experience with the current spectrum allocation and management program."¹¹² Further, AMRA asserts that neither the required common database, nor the means for creating and updating such a database in real time are available. ATA states that no problem exists in the radio services.¹¹³ The Coalition of Industrial Land Transportation Land Mobile Radio Users states: "clearly the public interest and Congressional objectives would not be served by the adoption of policies which cast aside the expertise of the well-established and well-functioning coordinator system - expertise which will be especially valuable in facilitating the introduction of new technologies in the private land mobile bands."¹¹⁴

50. Decision. While varying views were expressed in the comments regarding our proposal for consolidation, we continue to believe that consolidation of the PLMR radio services into 2-4 radio services is essential to our goal of increasing efficiency and providing for more flexible spectrum use. Consolidation is desirable to ensure more efficient distribution of the additional channels created as a result of the transition to narrowband technology. Our goal is to generally equalize the opportunity cost of spectrum usage across the PLMR environment. In addition, consolidation will permit licensees to utilize technologically innovative and efficient equipment. Further, maintaining the 20 radio services is administratively burdensome; consolidation will lead to greater operational efficiency for users and promote more flexible use of the spectrum. We note however, that we are departing from the proposal in the Refarming Notice. The plan for consolidation presented in the Refarming Notice provides an initial guideline for consolidation. We are not implementing that plan at this time. Instead, we will give the users in the PLMR community a further opportunity to submit a proposal that reflects the interests and the needs of the PLMR community. PLMR users can best assess their needs and submit a proposal that is representative of the PLMR community and that is mutually agreeable, reasonable, and workable. In addition, we encourage each frequency coordinator to participate, together with the PLMR community, so that they may assess the needs of the user groups. In this regard, it is our intention to create competition in the frequency coordination function by allowing users in the newly created service groups to use the services of any recognized frequency coordinator. We ask the users and frequency coordinators to provide guidance in their consolidation proposal on how this can best be accomplished and on how the existing databases can be shared to ensure fair competition among all of the frequency coordinators. Further, the consolidation proposal should explore creating and implementing a national real

¹¹² Comments of AMRA at 6.

¹¹³ Comments of ATA at 9.

¹¹⁴ Comments of the Coalition of Industrial Land Transportation Land Mobile Radio Users at 13.

time database to reflect frequency assignments, as expeditiously as possible.¹¹⁵ Also, coordination fees should be discussed in the consolidation proposal filed with the Commission.

51. Most of the objections to consolidation addressed processing difficulties. Others objected to the Refarming Notice's proposal to consolidate services into three categories, and several suggested alternative plans. Our approach gives PLMR users latitude in developing a consolidation proposal which has broader support from the user community. We emphasize, however, that in developing a consolidation proposal, the users should consider that the intended purpose of consolidating radio services is to distribute assignments between low-use and high-use groups more evenly, to simplify interservice sharing procedures, to organize channel allocations that will enable licensees to more easily utilize advanced technologies, and to organize the services in such manner to achieve more efficient and flexible spectrum use. Achieving a consensus on a consolidation plan is the ultimate objective. Although a consensus proposal would be ideal, we are not at this time establishing an advisory committee under the Federal Advisory Committee Act, 5 U.S.C. App. 2, or a negotiated rule making committee, P.L. No. 101-648, 105 Stat. 4969 (1990), 5 U.S.C. §§ 581-590; rather, we are merely encouraging the PLMR community, together with the frequency coordinators, to submit their further views.

52. Since we are further soliciting the views of PLMR users regarding a consolidation proposal representative of the interests and needs of the PLMR community and frequency coordinators, we postpone issuance of a plan in this document. We will give the PLMR community the opportunity to negotiate and submit a comprehensive consensus plan for consolidation to the Commission within 3 months of the effective date of this Report and Order. While not advocating a specific plan for consolidation, nor expressing a preference for the specific designation of the new broad categories, we conclude that reducing the radio services to between 2 (public safety and all other users) -4 user groups is reasonable.

53. We acknowledge that not all users in the PLMR community support the move toward consolidation. We take this approach however, because we believe that maintaining the existing number of services is outmoded and no longer works as efficiently as when the discrete services were first developed and the spectrum was less heavily utilized. We hope that by encouraging PLMR user input, the concerns of all commenters will be considered. Some of the most vocal advocates for maintaining discrete services are Public Safety users, who state that Public Safety is a unique radio service and should remain unchanged to protect the integrity and operation of the service. As we have described, we recognize the importance of the different services, particularly Public Safety, and encourage users to develop a proposal which includes a Public Safety pool. Further, we recommend that users provide clear guidelines as to the requirements for inclusion in the Public Safety pool to

¹¹⁵ A "real time database" is a database in which each coordinator would immediately update upon recommendation of a specific frequency,

prevent overcrowding and to maintain the critical functions of the users included within this pool. Additionally, we recommend that users consider whether a single coordinator or multiple coordinators should be used for public safety users. Further, while some commenters argue that the existing system of radio services have served the PLMR community well over the last three decades, spectrum use can be more evenly distributed under a system of consolidation. This change in the system can work to improve the efficiency of the spectrum environment.

54. We disagree with those commenters who contend that the coordination process would be negatively affected if the radio services are consolidated. In the Refarming Notice, we proposed that coordinators continue to perform their current role in the PLMR spectrum and we specifically proposed that licensees be permitted to use any frequency coordinator desired. We did not propose to alter the entire coordination system. Rather, we proposed that users be given latitude to seek the management and assistance of any frequency coordinators desired. These coordinators are familiar with the process, the users, and the regulated spectrum. Finally, while not advocating the adoption of the multiple coordinator design discussed in the Refarming Notice, we believe that this approach would be consistent with our commitment to encourage more flexibility in the PLMR spectrum. Further, such a system, we believe, will promote competition and benefit PLMR users.

55. Therefore, based upon the discussion above, we have decided to consolidate the PLMR services below 800 MHz. We believe that consolidation permits the introduction of marketplace forces and competition into this system. We will issue final rule amendments on this subject approximately 6 months after the effective date of this order without further notice. These rule amendments will incorporate the PLMR community's consensus plan, if consensus is achieved within the rubric of this Report and Order.

E. Technical Parameters.

56. Section B of this Report and Order discusses our proposed channelization plan, comments on that plan, and a discussion of our decision to establish 7.5 kHz channel spacing in the 150-174 MHz VHF frequency band and 6.25 kHz channel spacing in the 421-512 MHz UHF frequency band. In this section, we discuss, in further detail, the channelization plans and related technical parameters that we are adopting.

(1) Band Channelization Plans

57. **150-174 MHz VHF:** For frequencies (channels) authorized in the 150-174 MHz band, we generally adopt 6.25 kHz wide channels that are spaced 7.5 kHz apart. This

maintaining all current frequency designations.¹¹⁶ Within each individual radio service allocation, interleaved channels are created by assigning channels every 7.5 kHz higher in frequency than each existing channel.¹¹⁷ In instances where a lower frequency adjacent channel is not allocated to the private land mobile radio services, we are creating an interleaved channel 7.5 kHz lower in frequency than the existing PLMR channel. This interleaved channel will be designated for 6.25 kHz bandwidth operation only in order to minimize the potential of interference to these other services. Each interleaved channel will have the same limitation restrictions, except in certain cases for authorized bandwidth, as the channel which is 7.5 kHz below it.¹¹⁸ In cases where an existing channel is shared by two or more radio services, the interleaved channel will also be shared among those same services. Where an existing channel is assigned to a single radio service, the interleaved channel will be allocated to only that radio service. Accordingly, the Table of Frequencies listed in the rule section applicable to each radio service, except for the Radiolocation Service, is amended to include the newly created channels. Transition to narrowband channels in the VHF band is shown in Appendix A, Figure 3.

58. The 161.610-174 MHz band is dominated by users other than Part 90 private land mobile licensees.¹¹⁹ In most cases, the channels for Part 90 use in this band are either not contiguous or their permissible use is limited.¹²⁰ The Private Land Mobile Service has a narrow frequency allocation between 173.2 MHz and 173.4 MHz which is not shared with other services. Most frequencies in this band are designated for radio control or telemetry use, and except for frequencies near the band edges, frequencies are spaced 12.5 kHz apart. Frequencies in this band are heavily used in 11 of the Part 90 radio services. Considering their specialized use by a number of different radio services, and their unique channel spacing arrangement, we conclude that it would not be justifiable to rechannelize this small band in order to obtain a few additional frequencies. Therefore, these frequencies will not

¹¹⁶ Channels designated for paging-only are not being narrowbanded and will remain wideband. Also, certain current low power (color dot) and itinerant channels will not be narrowbanded beyond 12.5 kHz. See paragraph 101.

¹¹⁷ Existing channels are those channels available for licensing prior to the effective date of the rules adopted in this proceeding.

¹¹⁸ In instances where an interleaved channel is created 7.5 kHz lower in frequency than a existing channel, it will have the same limitation restrictions, except in certain cases for authorized bandwidth, as the channel which is 7.5 kHz above it.

¹¹⁹ Most frequency allocations in this band are for Government/Non-Government shared use in the Maritime Mobile Service and for Government fixed and mobile use.

¹²⁰ As an example, eight frequencies in the 169-171 MHz band are designated for low-power wireless microphone operation, and twenty others for use in hydrological or meteorological operations.

be subject to the decisions in this proceeding and will retain their current spacings and authorized channel bandwidths.

59. The Refarming Notice proposed to eliminate 47 C.F.R. § 90.271. This section provides for narrowband (5 kHz) channels that are offset by 2.5 or 7.5 kHz from current channel centers in the 150-170 MHz range. These channels are now inconsistent with the new VHF channelization plan. Therefore, we are adopting our proposal to eliminate 47 C.F.R. § 90.271. Existing licensees on these frequencies may be subject to interference as new frequencies are authorized. However, if interference is not experienced, they will be permitted to remain on their currently authorized frequencies until August 1, 2001, after which they will be required to move to one of the new VHF channels.

60. 421-512 MHz UHF. Except as otherwise noted, for frequencies (channels) authorized in the 421-512 MHz band, we are establishing 6.25 kHz wide channels while maintaining all current frequency designations.¹²¹ Within each individual radio service allocation, interleaved channels are created by assigning channels every 6.25 kHz higher in frequency than each existing channel. In instances where a lower frequency adjacent channel is not allocated to the private land mobile radio services, we are creating an interleaved channel 6.25 kHz lower in frequency than the existing PLMR channel. In order to minimize the potential of interference to these other services, this interleaved channel will be designated for 6.25 kHz bandwidth operation only.¹²² Each interleaved channel will have the same limitation restrictions, except in certain cases for authorized bandwidth, as the channel which is 6.25 kHz below it. In cases where an existing channel is shared by two or more radio services, the interleaved channels will be shared among those same services. Where an existing channel is assigned to a single radio service, the interleaved channels will be allocated to only that radio service. Accordingly, the Table of Frequencies listed in the rule section applicable to each radio service, except for the Radiolocation Service, is amended to include the newly created channels.

61. Frequencies in the 421-430 MHz band are available only in Buffalo, Detroit, and Cleveland.¹²³ Frequencies in the 470-512 MHz band are shared with UHF-TV channels

¹²¹ Channels designated for paging-only are not being narrowbanded and will remain wideband. Also, certain current low-power (color dot) and itinerant channels will not be narrowbanded beyond 12.5 kHz. See paragraph 101.

¹²² In instances where an interleaved channel is created 6.25 kHz lower in frequency than a existing channel, it will have the same limitation restrictions, except in certain cases for authorized bandwidth, as the channel which is 6.25 kHz above it.

¹²³ See 47 C.F.R. §90.273.

14-20 in eleven cities¹²⁴ and the Gulf of Mexico region.¹²⁵ Only specific frequencies are available in each city for use by Part 90 licensees.¹²⁶ Transition from the current channelization to the adopted narrowband channelization plan in these two UHF band is shown in Appendix A, Figure 5.

62. Frequencies in the 450-470 MHz band are currently spaced 25 kHz apart with secondary, low-power operations permitted on frequencies offset 12.5 kHz from assigned channels.¹²⁷ These low-power offset channels are very heavily utilized with the majority being licensed in the Business Radio Service. As discussed in the following paragraphs, the existence of offset low-power channels in this band requires that we adopt a somewhat different approach to new channel usage in this band. Transition from the current channelization to the adopted narrowband channelization plan in the 450-470 MHz UHF band is shown in Appendix A, Figure 4.

63. Section 90.267 of the Rules currently provides for low-power (2-watt) use of the 12.5 kHz offset channels in this band. Under our new channelization plan, these channels will no longer be offsets, but will be regularly assignable channels available in the various radio services as determined by the procedure outlined supra at paragraph 60. This will create instances where a channel that is currently available as an offset in more than one radio service will now be assignable in only one radio service. Therefore, licensees whose frequencies are no longer available in the radio service in which they are licensed will be grandfathered on their current frequency and we will permit these systems to be modified, expanded, and renewed.

64. Since the low-power offset channels will no longer exist as offsets and it is apparent that there is a continuing need for licensees to use low-power operations, we will permit the frequency coordinator for each radio service, as part of the coordination transition plan, to designate channels for low-power use. In order to promote flexibility for regions with differing communications requirements, we will permit coordinators to vary these designations by specific geographic region. Each coordinating entity will be required to maintain and supply to the public upon request, information on frequencies it designates for low-power use and the areas in which these frequencies are designated for such use.

65. Current licensees of 12.5 kHz offset frequencies, in addition to being subject to

¹²⁴ The rules specify use of this spectrum for thirteen cities, but TV Channels 14 and 15 in Cleveland, Ohio and 15 and 16 in Detroit, Michigan are not available for land mobile use due to concerns raised by Canada. See 47 C.F.R. § 90.303.

¹²⁵ See 47 C.F.R. § 90.315

¹²⁶ See 47 C.F.R. § 90.303

¹²⁷ See 47 C.F.R. § 90.267

the same transition schedule as high-power users, will have several options: 1) they may remain on the frequencies for which they are licensed; or, 2) move to frequencies designated specifically for low-power use. Users who choose to remain on their current frequency may achieve primary status by raising their output power, and by supplying their station coordinates (latitude and longitude) to the Commission through the appropriate frequency coordinator.¹²⁸ Users who wish to invoke this option must provide justification for raising their output power. Licensees on the offset frequencies who wish to remain at low-power on their current frequency will be secondary to new high-power operations on these frequencies. Users who choose to move to designated low-power frequencies will be given primary status on those frequencies after submitting their station coordinates to the Commission through the appropriate frequency coordinator.

66. Low-power operations that were permitted on offset frequencies under 47 C.F.R. § 90.267 have been beneficial to private land mobile operations. This rule provided licensees not requiring high-power radio systems access to many frequencies reserved for low-power operation, albeit on a secondary, non-interference basis. We conclude that similar rules, consistent with our new channelization plan, should be adopted. We, therefore, will make narrowband low-power offset channels available that are 3.125 kHz removed from any regularly assignable frequency in this band, unless otherwise noted.¹²⁹ These frequencies will be authorized on a secondary basis and will be subject to all frequency coordination requirements.

(2) Power/Antenna Height Limits

67. **Proposal.** Another important major technical issue that significantly affects spectrum efficiency is transmitter power and antenna height limits. It should be noted that limiting these parameters directly influences channel reuse which, in turn, ensures access to these bands. Currently, the maximum permitted output power level in the 150-174 and 450-470 MHz bands is 350 watts, with no reference to antenna height or effective radiated power (ERP). The Refarming Notice proposed limits for the 150-174 and 450-470 MHz bands of 300 watts ERP at 60 m (200 ft) height above average terrain (HAAT), with lesser power at greater antenna heights. These limits were chosen to permit general station spacings of about 80 km (50 mi) using a 10 dB desired-to-undesired signal strength

¹²⁸ Low-power offset users, being licensed as mobile units, now are generally authorized an area of operation such as a radius around a descriptive point, within a county or a city, etc., but not around a specific set of coordinates.

¹²⁹ Offset frequencies will not be authorized between the frequencies designated for paging-only in the Business Radio Service.

protection criteria.¹³⁰

68. Comments. Many commenters express concern that our transmitter power/antenna height proposal would be very costly to implement because they would force users to add additional stations to cover their existing service area.¹³¹ Commenters also point out the need for extensive rural coverage as well as coverage for specific geopolitical territories.¹³² Many commenters note the delicate balance between some entities serving small areas, others needing large service areas, and those operating "ribbon" systems.¹³³ LMCC submitted an alternative plan proposing to protect variable-sized service areas.¹³⁴ LMCC suggests incorporating tables, known as "Safe Harbor" tables, of power and antenna height limits based on service area radius. The Safe Harbor concept and tables proposed by LMCC was widely supported.¹³⁵

69. Decision. Upon review of the concerns expressed in the comments on our proposed power/antenna height limits, we remain convinced that steps must be taken that will permit increased channel reuse. The existence of high power systems can limit the choices available to other current and future co-channel users. In addition, the use of more transmitter power than necessary is contrary to the Commission's rules and reduces the amount of spectrum available for other users.¹³⁶ Based on the information before us, we will adopt a modified version of the Safe Harbor tables recommended by LMCC for the 150-174 MHz and 450-470 MHz bands. Further, to minimize the impact on existing

¹³⁰ The Refarming Notice proposed to retain the current power limitations for the 421-430 MHz band as specified in 47 C.F.R. § 90.279, and for the 470-512 MHz band as specified in 47 C.F.R. § 90.309.

¹³¹ Among others, see Comments of Florida Division of Communications, State of Illinois, and Orange County, California.

¹³² Comments of APCO at 30.

¹³³ Entities, such as railroads and petroleum pipelines, need to serve narrow geographic areas for relatively long distances. These types of operations are referred to as "ribbon" systems.

¹³⁴ Comments of LMCC at 17.

¹³⁵ Comments of UTC at 44; Joint Comments of ITA, the Council of Independent Communication Suppliers, the Telephone Maintenance Frequency Advisory Committee at 15.

¹³⁶ 47 C.F.R. § 90.205(a) states that applications for authorizations must specify no more power than the actual power necessary for satisfactory operation.

stations, these new rules will apply only to new stations.¹³⁷ Our purpose is to increase channel reuse while allowing PLMR licensees the flexibility they need to design individual systems. We believe that the Safe Harbor approach will provide this flexibility. These new power and antenna height limits are well suited for the diversity of service areas and operating requirements of licensees in the PLMR services.

70. The new rules contain tables for determining a station's allowable ERP which is dependent upon a justified service area radius and actual station antenna height.¹³⁸ The maximum service area radius permitted for all systems will generally be 40 km (25 mi) for the 150-174 MHz band and 32 km (20 mi) for the 450-470 MHz band. In all cases, the maximum allowable ERP is 500 watts, which is generally consistent with the vast majority of existing systems.¹³⁹ Because applications for frequencies in the 150-174 MHz and 450-470 MHz bands will now be required to include service area radius, ERP, and HAAT data, applicants will be required to provide this information.

71. The rules we are adopting do not provide for as close a co-channel frequency reuse distance as the rules proposed in the Refarming Notice. Therefore, to minimize the potential for co-channel interference, we will require applicants to justify requests for service area radii of greater than 40 km (25 mi) in the 150-174 MHz band and 32 km (20 mi) in the 450-470 MHz band.¹⁴⁰ Further, we will rely on the frequency coordinators to review applicant requests for power, antenna height, and service area. Frequency coordinators may request additional information from the applicant when needed to permit the coordinator to make a proper frequency recommendation. If the applicant disagrees with the coordinator's recommendation, the Commission will resolve the dispute on a case-by-case basis.¹⁴¹

72. We agree with LMCC that there should be flexibility in the rules to permit

¹³⁷ A *new station* is defined as one which is not functionally integrated with an earlier-installed system.

¹³⁸ The ERP/antenna height table for the 150-174 MHz band is based on providing a 37 dBu signal at the service area contour using R-6602, Figure 19. For the 450-470 MHz band, 39 dBu and R-6602, Figure 29 was used. See FCC Report No. R-6602, Development of UHF and VHF Propagation Curves, September 7, 1966.

¹³⁹ It is also consistent with our limits for the 220-222 MHz band.

¹⁴⁰ In general, we believe that individual PLMR base stations operating in an urban environment and using frequencies in the 150-174 MHz or 420-512 MHz bands should be designed to provide local operation.

¹⁴¹ In the event of a dispute, both parties will be required to justify their positions with technical data, but the applicant will be responsible for proof and persuasion in overturning the coordinator's recommendation.

applicants to propose use of higher transmitter powers when required, and thus we are also adopting rules that permit an applicant to request power/antenna heights in excess of those in the tables. Such requests must be accompanied by an engineering analysis demonstrating that the requested station parameters will not produce a signal strength in excess of 37 dBu for the 150-174 MHz band and 39 dBu for the 450-470 MHz band at any point along the edge of the service area that the applicant requests. The technical submission will be based on generally accepted good engineering practices and standards. This showing must be submitted to the appropriate frequency coordinator who may then recommend an ERP/HAAT appropriate to the applicant's service area. The coordinator will specify for each base station one of the service area radii designated in the appropriate table in § 90.205.

73. In sum, we believe that this action will reduce the incidence of over-powered systems, reduce background noise, and provide technical flexibility for PLMR licensees. These new standards should increase channel re-use and, thereby, improve spectrum efficiency. From the record, it appears that many existing licensees already comply with these limits. These new rules are also consistent with rules for 220-222 MHz and above 800 MHz and, thus, further our goal of developing and implementing consistent policies, where possible, across all frequency bands. Finally, the transmitter power/antenna height limits that we are adopting are sufficiently well defined to avoid placing a significant administrative burden on applicants, licensees, frequency coordinators, and the Commission.

(3) Adjacent Channel Separations.

74. **Proposal.** The amount of adjacent channel interference protection realized between radio systems is generally directly related to the frequency separation between them.¹⁴² The Refarming Notice, however, did not propose specific adjacent channel separation requirements.

75. **Comments.** Not having proposed or requested comments on this issue, when adjacent channel separation for interference protection was mentioned in the comments, it was in a very general manner without specific recommendations being made. Also, since we are adopting channelization plans different from our proposal, comments received on this issue are generally no longer accurate.

76. **Decision.** The level of interference protection provided by the frequency

¹⁴² The first adjacent channels are defined as the channels immediately above and immediately below a selected channel. The second adjacent channels are those channels, one channel removed from a selected channel. The third adjacent channels are three removed and so on. Since, not all PLMR users will transition to narrowband technologies at the same time, it may be necessary when determining adjacent channel interference protection requirements, to consider not only the first adjacent channel, but also the second and even the third adjacent channel.

separation between current assignments and new assignments using frequencies resulting from channel splitting may not be sufficient to permit same-area high-power operation.¹⁴³ Thus, in order to not degrade communications quality below that presently afforded land mobile licensees in these bands, in some situations it may be necessary to place certain restrictions on the operation of new adjacent channel assignments, such as requiring a geographic separation or operation at substantially reduced power. Specific restrictions will depend on a number of system parameters such as transmitter power, antenna height, and distance between stations, all of which may vary considerably between systems. We believe that there is not a sufficient record in the comments on which to base specific adjacent channel station separation requirements with respect to the new channelization plan. We also believe that the frequency coordinators, with their knowledge of user requirements and local conditions, are in a better position than the Commission to determine separation distances needed in each case. Accordingly, we are not adopting any specific mileage separation requirements at this time. The current separation requirements in 47 C.F.R. § 90.173 will remain in effect until June 1, 1996. After this date we will require the appropriate frequency coordinators to review applications for adjacent channel usage and determine appropriate separation distances based upon the technical characteristics of proposed and existing station(s). We will revisit this issue if the land mobile community believes specific adjacent channel station distance separations are needed.

(4) Authorized Channel Bandwidth.

77. Proposal. The Refarming Notice proposed channel spacings of 5 kHz for the 150-174 MHz (VHF) band and 6.25 kHz for the 420-512 MHz (UHF) band with authorized bandwidths of 4 kHz and 5 kHz respectively (80% of the channel spacings).

78. Comments. The comments contained extensive discussions on channel spacing. Except for commenters supporting 5 kHz channels in both the VHF and UHF bands,¹⁴⁴ most commenters did not specifically address the 4 kHz authorized bandwidth proposed for the VHF band. Stone comments that techniques are available that would permit authorization of full channel bandwidth rather than the 80% authorized bandwidths as proposed in the Refarming Notice. However, Stone also asserts that the proposed bandwidths are probably sufficient for those systems whose operational characteristics do not require the use of the full channel width.¹⁴⁵ The Telecommunications Industry Association (TIA) and Motorola recommend that the authorized bandwidth for the UHF band be increased from 5 kHz to

¹⁴³ About 70 dB adjacent channel protection, determined from transmitter and receiver design parameters, is generally needed for same area operation.

¹⁴⁴ Comments of Securicor at 7, SEA at 8 and 14, and AMI at 5.

¹⁴⁵ Comments of Stone at 7.

6 kHz.¹⁴⁶ E.F. Johnson states that the use of 5 kHz or 6.25 kHz channelization should be revisited in another rule making proceeding, and therefore, the Commission should indicate that any occupied (authorized) bandwidth rules are transitional.¹⁴⁷ GEC-Marconi indicates that the proposed 5 kHz UHF authorized bandwidth will require very high modulation level schemes resulting in increased equipment complexity.¹⁴⁸ UPS, while not specifically discussing the actual authorized bandwidth of a narrowband channel, states that success has been achieved in providing high-capacity narrowband channels at 220 MHz (where the authorized bandwidth is 4 kHz) and, that the transition to channels spaced as narrow as 5 kHz is both feasible and generally desirable for the frequency bands below 512 MHz.¹⁴⁹

79. Decision. As previously discussed, we are adopting a channel plan in which frequencies are assigned every 7.5 kHz in the 150-174 MHz VHF band and every 6.25 kHz in the 421-512 MHz UHF band. In the transition to narrowband operation, we will authorize licensees to operate in the 150-174 MHz and 421-512 MHz bands with either a 12.5 kHz or 6.25 kHz channel bandwidth. Considering our channeling plan, and after analysis of the comments concerning authorized bandwidths, we are adopting maximum single channel authorized bandwidths that we consider appropriate for both voice and non-voice applications. We agree with TIA and Motorola that for 6.25 kHz channels, our proposed 5 kHz authorized bandwidth should be increased to 6 kHz to accommodate a 9600 bits per second CQPSK signal.¹⁵⁰ We concur with the comments and conclude that these bandwidths will accommodate both reduced deviation analog systems and digital systems utilizing advanced modulation techniques.

80. Accordingly, applicants for new stations in the 150-174 MHz and 421-512 MHz bands requesting authorization to operate on frequencies with a 12.5 kHz channel bandwidth will be authorized a maximum bandwidth of 11.25 kHz.¹⁵¹ Applicants requesting to operate on frequencies in the 150-174 MHz and 421-512 MHz bands with a 6.25 kHz channel bandwidth will be authorized a maximum bandwidth of 6 kHz. Bandwidths for wideband systems will be authorized on a case-by-case basis.

¹⁴⁶ Comments of TIA at B3, and Motorola at C2.

¹⁴⁷ Comments of E.F. Johnson at 13.

¹⁴⁸ Comments of GEC-Marconi at 4.

¹⁴⁹ Reply comments of UPS at 5.

¹⁵⁰ See Comments of Motorola at C2 and TIA at B3.

¹⁵¹ See infra para 87.

(5) Emission Masks.

81. We consider the emission mask to be one of the most significant factors in the technical standards we are adopting in this proceeding. To maximize spectrum efficiency, the limited bandwidth in a narrowband channel must be utilized as fully as possible for maximum information transfer. This requires that the shape of the emission mask be designed to permit reasonable and practical information transfer without excessively expensive filtering requirements. At the same time, out-of-band emission limits must be judiciously selected to provide acceptable adjacent channel protection.

82. Proposal. The Refarming Notice proposed an emission mask for equipment operating on 5 kHz spaced frequencies in the 150-174 MHz VHF band that was identical to the mask currently specified in the Rules for the 5 kHz spaced frequencies in the 220-222 MHz band, except that the attenuations would be specified for frequencies referenced from the edge rather than the center of the authorized bandwidth. This would permit the same emission mask to apply to a single channel or to a wideband channel if contiguous channels were "stacked".

83. The Refarming Notice also proposed an emission mask for the 421-512 MHz UHF band that was designed to provide 40 dB of attenuation at the edge of the authorized channel, 50 dB at the edge of the adjacent channel's authorized bandwidth, and 65 dB after the center of the adjacent channel. The mask's emission attenuations were specified from the edge of the authorized bandwidth and thus, the mask was applicable to both 12.5 kHz and 6.25 kHz channel spacings.

84. Comments. Commenters advocating a 5 kHz channel spacing supported our proposed 5 kHz channel VHF mask.¹⁵² SEA states that the proposed mask provides a "reasonable amount of inherent real-world protection" to adjacent channels and thus, would not require geographic separation between adjacent channels, regardless of technology or bandwidth.¹⁵³ UPS expresses support, stating that the proposed mask, which is based upon the existing 220 MHz mask, would allow a wide variety of modulations without requiring adjacent channel coordination.¹⁵⁴

¹⁵² These included SEA, UPS, NTT, and Uniden. Securicor, an advocate of 5 kHz channelization, suggests that the out-of-band emission limits of the UK standard MPT 1736, be considered. Commenters supporting 12.5 kHz VHF channels (LMCC, Ericsson, and AAR) or 6.25 kHz VHF channels (GEC-Marconi and those supporting the APCO-25 concept) did not make specific reference to the 5 kHz mask proposed in the Refarming Notice.

¹⁵³ Comments of SEA at 14.

¹⁵⁴ Reply Comments of UPS at 3.

85. Commenters primarily favoring a 12.5 kHz channelization plan suggest a mask designed specifically for 12.5 kHz spacing that would be applicable to either VHF or UHF equipment and applicable to both analog and digital modulations.¹⁵⁵ TIA's comments also include a recommended mask for equipment operating on frequencies with 6.25 kHz channel spacing. TIA notes that its proposed masks are derived from committee work performed by various equipment manufacturers in APCO's Project 25, and are intended to provide a transition from current equipment to 12.5 kHz digital and analog equipment, while also supporting optional use of 6.25 kHz equipment.¹⁵⁶ TIA states that its suggested 6.25 kHz mask will allow single sideband analog modulation or the CQPSK digital modulation as proposed in APCO Project 25. GEC-Marconi states that they support our proposed 6.25 kHz mask, although their comments pictorially show a mask significantly different from our proposed mask.¹⁵⁷ Stone suggests a mask where the authorized bandwidth could equal the channel spacing provided a specific frequency stability is met, but that 50 dB of attenuation must be provided at the edge of the authorized bandwidth of the adjacent channel.¹⁵⁸ Ericsson recommends an emission mask for 12.5 kHz channels that would permit the use of TDMA modulation.¹⁵⁹

86. **Decision.** Our decision in this proceeding is to establish narrowband channel bandwidths in both the 150-174 MHz VHF and 421-512 MHz UHF bands. We will, however, allow the use of equipment designed to operate on a 12.5 kHz channel bandwidth in each band. We have carefully considered the comments that discuss the various factors involved in developing appropriate emission masks for equipment operating with channel bandwidths narrower than 25 kHz. With respect to the emission mask proposed in the Refarming Notice applicable to equipment operating with a 12.5 kHz bandwidth, we concur with the comments that our proposed mask is too restrictive and that it would make existing

¹⁵⁵ Comments of TIA at B1. Motorola and E.F. Johnson support the TIA proposal.

¹⁵⁶ *Id.* at 13.

¹⁵⁷ Comments of GEC-Marconi at Figure 5 for the 5 kHz channel mask and Figure 7 for the 6.25 kHz mask. These masks show a "brick wall" configuration at the edge of the proposed authorized bandwidth to 65 dB rather than, as proposed, 30 dB and then sloping to 65 dB in accordance with a specified formula.

¹⁵⁸ Comments of Stone at 7. Stone proposes that Commission permit the maximum authorized bandwidth, defined as containing those frequencies upon which 99% of the radiated power appears, extended to include any discrete frequency upon which the power is at least 0.25% of the total radiated power, to be equivalent to the channel spacing, if the frequency stability is kept to 0.1 ppm. The attenuation at the edge of the authorized bandwidth of the adjacent channel is required to be 50 dB.

¹⁵⁹ Ex parte filing from the Ericsson Corporation to William F. Caton, Federal Communications Commission, dated February 6, 1995 and addendum filed March 8, 1995.

or contemplated 12.5 kHz equipment generally non-compliant. Existing equipment would require redesign and the necessary modifications would not only be expensive but would delay the use of 12.5 kHz bandwidth equipment in the marketplace. Considering the technical discussions in the comments of adjacent channel protection, we agree that the 12.5 kHz emission mask proposed by TIA, although less restrictive than our proposed mask, provides acceptable adjacent channel protection. However, the TIA mask is designed to primarily accommodate only reduced deviation analog and digital FDMA modulations.

87. The emission mask submitted by Ericsson for equipment with a 12.5 kHz bandwidth appears to be more flexible than the TIA mask because it would not only permit the use of equipment that meets the TIA mask, but also equipment designed for wideband modulations, such as QPSK modulation. The basic difference between the Ericsson mask and the TIA mask is in the width of the mask's flat top region. The TIA mask, allowing for a 5 kHz authorized bandwidth, is flat until 2.5 kHz removed from the center frequency while the Ericsson mask, allowing for an 11.25 kHz authorized bandwidth, has a flat top that extends 5.625 kHz from the center frequency to accommodate the other modulation spectrums. There is some difference in the mask's skirt region, however, with the Ericsson mask providing less protection at the edge of the channel. We conclude, therefore, that the flat top region of the 12.5 kHz emission mask recommended by Ericsson will allow the use of any generally used modulation technique, and that the TIA suggested mask will provide better adjacent channel protection in the skirt region when compared to the Ericsson mask. We, therefore, are adopting for equipment designed to operate with a 12.5 kHz channel bandwidth in the 150-174 MHz and 421-512 MHz bands, a mask which incorporates the best attributes of the Ericsson and the TIA recommendations. Our adopted mask has the flat top characteristic of the Ericsson suggested mask and the roll off characteristic for the skirt region of the TIA suggested mask.

88. Regarding the narrowband emission mask, TIA states that their suggested 6.25 kHz mask was developed in support of APCO Project 25, and is also based upon our existing 220 MHz band mask as well as the 6.25 kHz mask proposed in the Refarming Notice. As with its 12.5 kHz mask, TIA's 6.25 kHz mask is intended for both analog and digital modulation. The only difference between our proposed mask and TIA's suggested mask is that the flat top of the TIA mask is extended to 3 kHz removed from the center frequency rather than the 2.5 kHz we proposed in order to accommodate a 9600 bps CQPSK modulation signal. Because there was no opposition to either our proposed or TIA's suggested mask, we are adopting the mask suggested by TIA for equipment that operates with a 6.25 kHz bandwidth in the 421-512 MHz band.

89. We disagree with Stone's suggested mask because the emission mask shape would be determined not only by the transmitter's frequency stability but also by the authorized bandwidth of an adjacent channel, which may vary depending upon the needs of the adjacent channel user. Separate type acceptance would then be required for each transmitter having different filtering to provide the needed mask shape. Also, licensing procedures would become complex because determination of an adjacent channel's bandwidth

would require adjacent channel coordination.

90. In the adopted emission mask rules, we are including provisions for equipment designed to operate on multiple contiguous channels. We are also specifying general requirements for instrumentation and procedures to be used when measuring equipment emissions. These are intended to provide general guidance to manufacturers. With the broad range of equipment modulations and system requirements that may be encountered, should our requirements prove inadequate or inappropriate, we will permit applicants for equipment type acceptance to utilize alternate procedures provided prior Commission approval is obtained.

(6) Frequency Stability.

91. Proposal. Following industry standards, the Refarming Notice proposed that transmitter frequency stability be specified in parts per million (ppm) rather than in percent of the carrier frequency. The Refarming Notice proposed a frequency stability of 0.1 ppm for 150-174 MHz and 421-512 MHz base stations, and stabilities of 1.5 ppm and 1.0 ppm for 150-174 MHz and 421-512 MHz mobile units respectively. The Refarming Notice further proposed to retain Part 90 frequency stability requirements for all other bands.

92. Comments. In its comments, TIA recommends differing frequency stabilities for the VHF and UHF bands for equipment designed to operate on 12.5 kHz or 6.25 kHz channels. SEA, supporting 5 kHz channelization in the VHF band, expresses support for the frequency stability schedule proposed in the Refarming Notice.¹⁶⁰ Other equipment manufacturers did not specifically address the frequency stability issue.

93. Decision. Narrower channel spacing increases the importance of frequency stability to reduce adjacent channel interference. As mentioned previously in the discussion on emission masks, a properly designed emission mask must take frequency stability into consideration. As stated by TIA, their recommended frequency stability requirements for 12.5 kHz equipment are based on the performance of equipment that has been operating for a number of years in Europe and Asia in the same frequency bands, thus demonstrating that the frequency stability recommendations, coupled with TIA's recommended emission masks, will provide adequate adjacent channel interference protection. Therefore, we conclude that TIA's proposal provides a reasonable transition from current equipment to advanced 12.5 kHz digital and analog equipment while also supporting the optional use of 6.25 kHz equipment. Accordingly, we adopt the frequency stabilities as proposed by TIA for base and mobile stations designed for operation with either a 12.5 kHz or 6.25 kHz bandwidth in the 150-174 MHz and 421-512 MHz bands. These frequency stabilities are the minimum acceptable and are listed in the table of § 90.213(a). Manufacturers may choose to produce equipment with greater frequency stability.

¹⁶⁰ Comments of SEA at 15.

94. Although the Refarming Notice proposed frequency stabilities for the 150-220 MHz band, our decision herein does not include a frequency stability for the 216-220 MHz band. Operation in this band is secondary to Federal Government operations, and equipment operating in the 216-220 MHz band is required to comply with Federal Government technical standards. Also, we are retaining the current base and mobile station frequency stabilities in the 220-222 MHz band.

(7) **Spectrum Efficiency Standards.**

95. **Proposal.** The purpose of a spectrum efficiency standard is, in combination with a channelization plan, to expand capacity in a band of frequencies by requiring efficient operation. Such a standard should allow equipment manufacturers to offer a wide array of technologies using various bandwidths to satisfy diverse user needs. In the Refarming Notice, we proposed spectrum efficiency standards that would permit the use of non-standard bandwidths provided that such use is at least as efficient as narrowband technology.¹⁶¹ Since a communications link may convey either voice or data, two different formulas were proposed. With respect to voice transmissions, our efficiency standard required at least one voice circuit per channel being combined. For example, if four 6.25 kHz channels are combined to enable a 25 kHz TDMA technology, then the resulting system must contain at least four voice slots. Regarding an efficiency standard for digital technologies and data applications, we proposed a requirement of at least 4800 bits per second per communications link.¹⁶² These proposed spectrum efficiency standards were intended to increase technical flexibility.

96. **Comments.** Generally, this concept received strong support in the comments.¹⁶³ In their "User Coalition Plan", the User Associations state that "... licensees would be permitted to exceed the maximum channel spacings, ... upon a demonstration that their proposed system would operate with an efficiency that is equivalent to, or greater than the efficiency normally achievable in the stated bandwidth."¹⁶⁴ Few comments were received on our proposed efficiency standard for voice systems; most were in regard to our proposed standard for digital systems. Although the general approach is endorsed by the majority of commenters, many differed on how to define spectrum efficiency. Ericsson, for example, stated, "...the most germane measure of spectrum efficiency... is measured in terms of quantity of communications achieved per unit of occupied spectrum as a function of the

¹⁶¹ Refarming Notice, text under Appendix A, "Spectrum Efficiency Standards."

¹⁶² As proposed, a communications link was 5 kHz in the 150-174 MHz VHF band and 6.25 kHz in the 421-512 MHz UHF bands.

¹⁶³ Comments of E.F. Johnson, SEA, GEC-Marconi.

¹⁶⁴ Letter from User Associations to William F. Caton, Federal Communications Commission, dated January 13, 1995.

geographic area occupied by the signal and the time required to achieve the communications."¹⁶⁵ Others strongly agreed with our approach. For example, SEA notes that "the logistics of the implementation of any alternative to the Commission's enforcement of a simple standard is conspicuously absent from the comments."¹⁶⁶ GEC-Marconi recommends a standard of 1.28 bits/second/Hertz as a long term efficiency objective.¹⁶⁷ Finally, we note that the comments contained considerable discussion on potentially attainable spectrum efficiencies. Other possible formulas suggested in the comments suffer from the defect that the suggested spectrum efficiency measure would depend on the specific use, thus creating a significant compliance problem. For example, information per second per hertz depends on the exact nature of the information being communicated. Even a less elusive measure like bits per second per hertz per square kilometer depends on antenna gain and height, which varies from applicant to applicant.

97. Decision. After considering the comments on this issue, we are adopting our proposal contained in the Refarming Notice with minor modification. Although different efficiency standards were proposed for the VHF and UHF bands, we are adopting a common standard for all the refarming bands. In accordance with the transition dates for equipment in the 150-174 MHz VHF and 421-512 MHz UHF bands, we are adopting a spectrum efficiency standard of one voice channel per 12.5 kHz of channel bandwidth for equipment type accepted after August 1, 1996, and a spectrum efficiency standard of one voice channel per 6.25 kHz for equipment type accepted after January 1, 2005. Additionally, after August 1, 1996, equipment designed for data operation that uses more than a 6.25 kHz channel bandwidth, must meet a minimum efficiency standard of at least 0.768 bits per second per Hertz.¹⁶⁸ At the chosen standard of 0.768 bps/Hz, the 6.25 kHz equipment will have a data rate of 4800 bps, and the 12.5 kHz equipment will have a data rate of 9600 bps. These are standard data rates. Based on the comments, we believe that this standard is readily attainable. This standard will be incorporated into the type acceptance process by having equipment manufacturers certify as part of their application for type acceptance that their equipment meets the spectrum efficiency standard. Therefore, licensees and new applicants would be assured that any equipment they purchase would comply with the spectrum efficiency standard.

(8) Itinerant and Color Dot Frequencies.

98. Proposal. The Refarming Notice proposed that 45 VHF and UHF frequencies

¹⁶⁵ Comments of Ericsson at 15.

¹⁶⁶ Reply Comments of SEA at 6.

¹⁶⁷ Comments of GEC-Marconi at 14.

¹⁶⁸ Equipment designed for voice and data operation must meet the efficiency standards for both voice and for data.

be designated specifically for itinerant operations at unspecified temporary locations and that users of these frequencies would not have any protection from other itinerant co-channel licensees.

99. Comments. There was no opposition to our proposal for use of the itinerant frequencies. Ritron, in its comments, recommends that we retain certain low power and itinerant frequencies in the Business Radio Service as conventional FM (12.5 kHz) channels for "very low tier, low cost, entry level communications".¹⁶⁹ These frequencies are commonly referred to in the marketplace as "color dot" channels¹⁷⁰ and are becoming increasingly popular. The majority of radios operating on these channels are relatively inexpensive, one-watt handheld portables, and are readily available from discount retailers and mail order sources. The comments indicate that this type of equipment serves an important need. We concur that there should be entry-level, economical equipment made available to licensees who do not have a need for more sophisticated and more expensive land mobile radios. Therefore, we will reserve the frequencies currently designated for low power and itinerant operations for continued use in this manner.

100. Further, in reply comments, Motorola recommends that additional low-power itinerant channels be created. Motorola states that these channels "serve a variety of business communications needs as evidenced by the incredible loading that the itinerant channels currently support", and "that there is a growing demand for low-cost and low-power consumer portable land mobile equipment to serve individual recreational needs"¹⁷¹ Motorola recommends that the Commission consider designating several channels for this use.

101. Decision. We agree with these assessments. Accordingly, we are making six additional frequencies in the 150 MHz band available to the Business Radio Service for low-power and itinerant operations. These are: 151.700 MHz, 151.760 MHz, and 154.5275 MHz for itinerant use, and 151.820 MHz, 151.880 MHz, and 151.940 MHz for low-power use. Operation on these new low power frequencies will be limited to a maximum channel bandwidth of 12.5 kHz and a maximum output power of 1 watt. Also, after January 1, 2005, we will continue to allow type acceptance of 12.5 kHz single mode radios that are designed to only operate on any of the color dot frequencies and have an output power of less than 2 watts.

¹⁶⁹ Comments of Ritron at 4 and 6.

¹⁷⁰ The operating frequencies of these radios are designated by a colored dot or star attached to the radio. Channels currently designated by manufacturers as color dot or star frequencies are: 151.625 MHz (Red dot), 154.570 MHz (Blue dot), 154.600 MHz (Green dot), 464.500 MHz (Brown dot), 464.550 MHz (Yellow dot), 467.850 MHz (Silver star), 467.875 MHz (Gold star), 467.900 MHz (Red star), and 467.925 MHz (Blue star). The frequencies 469.500 MHz and 469.550 MHz are also designated as itinerant in § 90.75(b).

¹⁷¹ Reply comments of Motorola at 25.

(9) Type Acceptance.

102. As licensees transition to narrowband technologies, a primary concern of many manufacturers is that they be able to provide continued support to their existing customer base. With respect to this rule part and proceeding, a grant of type acceptance will be required for new multi-mode, or narrowband equipment. The new grant of type acceptance may cover a new transmitter design and/or upgraded units.¹⁷² Existing wideband (25 kHz) units that have the inherent capability for either multi-mode or narrowband operation may have the current grant of type acceptance modified to show the additional capability by filing a modification request which demonstrates that the original unit complies with the new technical requirements applicable to multi-mode or narrowband operation.

103. In cases where manufacturers have developed a conversion kit to retrofit existing wideband equipment and cause the modified unit to conform to the new technical requirements for new multi-mode or narrowband operation, we will allow field modifications to add multi-mode or narrowband capability to equipment currently installed. So that this equipment can be recognized as having the revised capability, the modifying party, typically the manufacturer or its representative, must replace the existing FCC ID label with a new label that corresponds to the FCC ID of the associated new transmitter which was type accepted with the multi-mode or narrowband capability.

(10) Miscellaneous Technical Issues.

104. Emission classifications. We continually receive inquiries concerning emission designator symbols from applicants filling out application forms. Therefore, to assist applicants in selecting the proper symbols, we are adding an introductory paragraph in 47 C.F.R. § 90.207 that defines in simple terms the most commonly used land mobile radio emission classification symbols and makes reference to the detailed discussion of emission classifications contained in 47 C.F.R. § 2.201.

105. Modulations. The Refarming Notice proposed that modulations other than frequency modulation (FM) could be utilized by equipment on the narrowband channels, and that frequency deviation limits, which are applicable only to FM, will no longer be specified for equipment designed to operate on these channels. Additionally, the new emission mask requirements make the need for a frequency deviation limit superfluous for FM equipment, and irrelevant for non-FM equipment. Therefore, because no comments opposed this proposal, we are eliminating references to frequency deviation limits for equipment operating in the 150-174 MHz and 421-512 MHz bands.

106. Spread spectrum. In the Refarming Notice, we proposed to permit the use of

¹⁷² Upgraded units are those units that are converted in the field to conform to a new transmitter design and performance specification.

direct sequence spread spectrum devices for public safety use during covert operations. Current Part 90 rules permit only frequency hopping spread spectrum to be used in the Police Radio Service. Under Part 15 of the Rules, both direct sequence and frequency hopping techniques may be used. Since there was no opposition to our proposal, we are amending Section 90.19 of the Rules to permit the use of direct sequence spread spectrum transmitters in the Police Radio Service.

107. Transmitter transient frequency criteria. Radio transmitters, when keyed on, require a very short period of time (in milliseconds) to "warm-up" and attain their designed operating frequency. During this short period of off-frequency operation, noise "chirps" are transmitted. A similar transient frequency behavior occurs when the transmitter is keyed off. Transmitters designed for digital transmissions produce in-band signals very close to an adjacent channel. Thus, noise "chirps" can cause interference to adjacent channel operations. The Refarming Notice proposed certain criteria to limit the amplitude of this type of noise. The comments indicate support for limiting these emissions. E.F. Johnson states that "[t]he Commission's regulations will insure that substandard equipment that could cause interference to other users will not be type-accepted."¹⁷³ The comments also indicate that since our original proposal, the industry has adopted voluntary standards, contained in EIA/TIA Standard 603, to limit these "chirps." Motorola "... points out that the EIA/TIA have already addressed the issue of transient frequency behavior in its publication SP-22108."¹⁷⁴ Motorola further states that "... since the industry has already addressed this matter through the adoption of voluntary standards, an FCC rule is unnecessary."¹⁷⁵ We disagree with Motorola. In order to assure that "chirps" do not cause excessive interfere to other land mobile licensees and to television receivers operating in adjacent bands, manufacturers must limit "chirps" in their equipment. Therefore, we are adopting standards similar to those used by industry for transient frequency behavior for equipment designed to operate on 25, 12.5, or 6.25 kHz channel bandwidths.

108. Exemption from technical standards. Section 90.217 of the Rules exempts transmitters used at stations licensed in the Business Radio Service from some technical standards of Part 90, Subpart I, if the transmitters employed do not exceed 120 milliwatts in output power. These transmitters, however, must meet limited out-of-band emission and frequency stability criteria. Section 90.217 has been modified to include additional out-of-band emissions limitations that are appropriate to the narrower channel bandwidths being established.

109. Lastly, we adopt several minor editorial changes to Part 90 to correct typographical errors, omissions, and obsolete text.

¹⁷³ Comments of E.F. Johnson at 25.

¹⁷⁴ Comments of Motorola at 34.

¹⁷⁵ Comments of Motorola at 34 and 35.